Department of Transportation
Federal Aviation Administration
Aircraft Certification Service
Washington, D.C.

TSO-C112e

Effective
Date: 09/16/13

Technical Standard Order

Subject: AIR TRAFFIC CONTROL RADAR BEACON SYSTEM/MODE SELECT (ATCRBS / MODE S) AIRBORNE EQUIPMENT

1. PURPOSE. This technical standard order (TSO) is for manufacturers applying for a TSO authorization (TSOA) or letter of design approval (LODA). In it, we (the Federal Aviation Administration, (FAA) tell you what minimum performance standards (MPS) your ATCRBS/Mode Select (Mode S) airborne equipment must first meet for approval and identification with the applicable TSO marking.

2. APPLICABILITY. TSO-C112e is applicable for new applications after the effective date of this TSO.

a. TSO-C112d will remain effective until March 13, 2015, after this date we will no longer accept applications for TSO-C112d.

b. ATCRBS / Mode Select (Mode S) airborne equipment approved under a previous TSOA may still be manufactured under the provisions of its original approval.

3. REQUIREMENTS. New models of ATCRBS / Mode Select (Mode S) airborne equipment identified and manufactured on or after the effective date of this TSO must meet the MPS qualification and documentation requirements in RTCA Document DO-181E, *Minimum Operational Performance Standards for Air Traffic Control Radar Beacon System/Mode Select (ATCRBS/Mode S) Airborne Equipment* Section 2 as amended by **Appendix 2** of this TSO.

a. Functionality. This TSO's standards apply to equipment intended to be used in aircraft to provide responses to Air Traffic Control (ATC) ground-based Secondary Surveillance Radar (SSR) and Traffic Alert and Collision Avoidance System (TCAS) interrogations. The ATCRBS/Mode S equipment may also support additional features as shown in RTCA/DO-181E, Section 1.4.4**.**

b. Failure Condition Classifications.

(1) Failure of the function defined in paragraph 3.a resulting in misleading range or altitude information is a major failure condition.

(2) Loss of the function defined in paragraph 3.a is a minor failure condition.

(3) Design the system to at least these failure condition classifications.

c. Functional Qualification. Demonstrate the required functional performance under the test conditions specified in RTCA/DO-181E, Sections 2.4 and 2.5 as modified by **Appendix 2**. If Elementary or Enhanced Surveillance functions are included, demonstrate the required functional performance under the test conditions specified in RTCA/DO-181E, Sections 2.6 and 2.7.

d. Environmental Qualification. Demonstrate the required performance under the test conditions specified in RTCA/DO-181E, Section 2.3, using standard environmental conditions and test procedures appropriate for airborne equipment. You may use a different standard environmental condition and test procedure than RTCA/DO-160G, *Environmental Conditions and Test Procedures for Airborne Equipment*, dated December 8, 2010, provided the standard is appropriate for the ATCRBS / Mode Select (Mode S) airborne equipment.

> **Note:** The use of RTCA/DO-160D (with Changes 1 and 2 only, incorporated) or earlier versions is generally not considered appropriate and will require substantiation via the deviation process as discussed in paragraph **3.g** of this TSO.

e. Software Qualification. If the article includes software, develop the software according to RTCA, Inc. document RTCA/DO-178B, *Software Considerations in Airborne Systems and Equipment Certification*, dated December 1, 1992 to the design assurance level consistent with the failure condition classification defined in paragraph **3.b** of this TSO.

> **Note**: The certification liaison process objectives will be considered satisfied after FAA review of the applicable life cycle data.

f. Electronic Hardware Qualification. If the article includes complex custom airborne electronic hardware, develop the component according to *RTCA, Inc. Document RTCA/DO-254, Design Assurance Guidance for Airborne Electronic Hardware* to the design assurance level consistent with the failure condition classification defined in paragraph **3.b** of this TSO. For custom airborne electronic hardware determined to be simple, RTCA/DO-254, paragraph 1.6 applies. *{Use this paragraph if the condition classification (defined in paragraph **3.b** of this TSO) is major, hazardous or catastrophic.}*

> **Note**: The certification liaison process objectives will be considered satisfied after FAA review of the applicable life cycle data.

g. Deviations. We have provisions for using alternate or equivalent means of compliance to the criteria in the MPS of this TSO. If you invoke these provisions, you must show that your

equipment maintains an equivalent level of safety. Apply for a deviation under the provision of 14 CFR § 21.618.

4. MARKING.

a. Mark at least one major component permanently and legibly with all the information in 14 CFR § 45.15(b). The marking must include the serial number. The marking must also include the transponder's functional level, minimum peak output power, and optional additional features in accordance with RTCA/DO-181E, Section 1.4.6 (Transponder Labeling). As a courtesy to operators and repair stations, and with the permission of RTCA, Inc., we have included a copy of Sections 1.4.3 through 1.4.6 in **Appendix 1**. In addition, because the transponder labeling scheme has been revised in RTCA DO-181E, **Appendix 1** also contains a cross-reference to the equipment marking currently in 14 CFR Part 43 appendix F.

b. Also, mark the following permanently and legibly, with at least the manufacturer's name, subassembly part number, and the TSO number:

(1) Each component that is easily removable (without hand tools); and,

(2) Each subassembly of the article that you determined may be interchangeable.

c. If the article includes software and/or airborne electronic hardware, then the article part numbering scheme must identify the software and airborne electronic hardware configuration. The part numbering scheme can use separate, unique part numbers for software, hardware, and airborne electronic hardware.

d. You may use electronic part marking to identify software or airborne electronic hardware components by embedding the identification within the hardware component itself (using software) rather than marking it on the equipment nameplate. If electronic marking is used, it must be readily accessible without the use of special tools or equipment.

5. APPLICATION DATA REQUIREMENTS. You must give the FAA aircraft certification office (ACO) manager responsible for your facility a statement of conformance, as specified in 14 CFR § 21.603(a)(1) and one copy each of the following technical data to support your design and production approval. LODA applicants must submit the same data (excluding paragraph **5.g**) through their civil aviation authority.

a. A Manual(s) containing the following:

(1) Operating instructions and equipment limitations sufficient to describe the equipment's operational capability.

(2) Describe in detail any deviations.

(3) Installation procedures and limitations sufficient to ensure that the ATCRBS / Mode Select (Mode S) airborne equipment, when installed according to the installation or operational

procedures, still meets this TSO's requirements. Limitations must identify any unique aspects of the installation. The limitations must include a note with the following statement:

> "This article meets the minimum performance and quality control standards required by a technical standard order (TSO). Installation of this article requires separate approval."

(4) For each unique configuration of software and airborne electronic hardware, reference the following:

(a) Software part number including revision and design assurance level,

(b) Airborne electronic hardware part number including revision and design assurance level,

(c) Functional description, and

(d) Failure condition classification.

(5) A summary of the test conditions used for environmental qualifications for each component of the article. For example, a form as described in RTCA/DO-160G, *Environmental Conditions and Test Procedures for Airborne Equipment*, Appendix A.

(6) Schematic drawings, wiring diagrams, and any other documentation necessary for installation of the ATCRBS / Mode Select (Mode S) airborne equipment.

(7) List of replaceable components, by part number, that makes up the ATCRBS / Mode Select (Mode S) airborne equipment. Include vendor part number cross-references, when applicable.

b. Instructions covering periodic maintenance, calibration, and repair, for the continued airworthiness of ATCRBS / Mode Select (Mode S) airborne equipment. Include recommended inspection intervals and service life, as appropriate.

c. If the article includes software: a plan for software aspects of certification (PSAC), software configuration index, and software accomplishment summary.

d. If the article includes simple or complex custom electronic hardware: a plan for hardware aspects of certification (PHAC), hardware verification plan, top-level drawing, and hardware accomplishment summary (or similar document, as applicable).

e. A drawing depicting how the article will be marked with the information required by paragraph 4 of this TSO.

f. Identify functionality or performance contained in the article not evaluated under paragraph **3** of this TSO (that is, non-TSO functions). Non-TSO functions are accepted in parallel with the TSO authorization. For those non-TSO functions to be accepted, you must declare these functions and include the following information with your TSO application:

(1) Description of the non-TSO function(s), such as performance specifications, failure condition classifications, software, hardware, and environmental qualification levels. Include a statement confirming that the non-TSO function(s) don't interfere with the article's compliance with the requirements of paragraph **3**.

(2) Installation procedures and limitations sufficient to ensure that the non-TSO function(s) meets the declared functions and performance specification(s) described in paragraph **5.f.(1)**.

(3) Instructions for continued performance applicable to the non-TSO function(s) described in paragraph **5.f.(1).**

(4) Interface requirements and applicable installation test procedures to ensure compliance with the performance data defined in paragraph **5.f.(1).**

(5) Test plans, analysis and results, as appropriate, to verify that performance of the hosting TSO article is not affected by the non-TSO function(s).

(6) Test plans, analysis and results, as appropriate, to verify the function and performance of the non-TSO function(s) as described in paragraph **5.f.(1).**

g. The quality system description required by 14 CFR § 21.608, including functional test specifications. The quality system should ensure that you will detect any change to the approved design that could adversely affect compliance with the TSO MPS, and reject the article accordingly. (Not required for LODA applicants.)

h. Material and process specifications list.

i. List of all drawings and processes (including revision level) that define the article's design.

j. Manufacturer's TSO qualification report showing results of testing accomplished according to paragraph **3.c** of this TSO.

6. <u>MANUFACTURER DATA REQUIREMENTS</u>. Besides the data given directly to the responsible ACO, have the following technical data available for review by the responsible ACO:

a. Functional qualification specifications for qualifying each production article to ensure compliance with this TSO.

b. Schematic drawings.

c. Wiring diagrams.

d. Material and process specifications.

e. The results of the environmental qualification tests conducted according to paragraph **3.d** of this TSO.

f. If the article includes software, the appropriate documentation defined in RTCA/DO-178B including all data supporting the applicable objectives in RTCA/DO-178B *Annex A, Process Objectives and Outputs by Software Level*.

g. If the article includes complex custom airborne electronic hardware, the appropriate hardware life cycle data in combination with design assurance level, as defined in RTCA/DO-254, Appendix A, Table A-l. For simple custom airborne electronic hardware, the following data: test cases or procedures, test results, test coverage analysis, tool assessment and qualification data, and configuration management records, including problem reports.

h. If the article contains non-TSO function(s), you must also make available items **6.a** through **6.h** as they pertain to the non-TSO function(s).

7. FURNISHED DATA REQUIREMENTS.

a. If furnishing one or more articles manufactured under this TSO to one entity (such as an operator or repair station), provide one copy or on-line access to the data in paragraphs **5.a** and **5.b** of this TSO. Add any other data needed for the proper installation, certification, use, or for continued compliance with the TSO, of the ATCRBS / Mode Select (Mode S) airborne equipment.

b. If the article contains declared non-TSO function(s), include one copy of the data in paragraphs **5.f.(1)** through **5.f.(4).**

8. HOW TO GET REFERENCED DOCUMENTS.

a. Order RTCA documents from RTCA Inc., 1150 18th Street NW, Suite 910, Washington, D.C. 20036. Telephone (202) 833-9339, fax (202) 833-9434. You can also order copies online at www.rtca.org.

b. Order copies of 14 CFR parts 21, 43 and 45, from the Superintendent of Documents, Government Printing Office, P.O. Box 979050, St. Louis, MO 63197. Telephone (202) 512-1800, fax (202) 512-2250. You can also order copies online at www.gpo.gov. Select "Access," then "Online Bookstore." Select "Aviation," then "Code of Federal Regulations."

c. You can find a current list of technical standard orders and advisory circulars on the FAA Internet website Regulatory and Guidance Library at http://rgl.faa.gov/. You will also find the TSO Index of Articles at the same site.

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Appendix 1. Mode S Transponder Marking Scheme and 14 CFR Part 43 Appendix F Cross-Reference

1.1. Purpose. This appendix describes the cross-reference for ATCRBS / Mode Select (Mode S) equipment markings into the classes referenced in 14 CFR Part 43 Appendix F as of the date of this TSO.

1.2. Detailed Cross-Reference. The TSO-C112e marking scheme does not match the classes called out in Appendix F of 14 CFR Part 43. The new TSO marking is based on RTCA Document DO-181E, Section 1.4.6 (Transponder Labeling), rather than the marking that had been defined previously in TSO-C112.

To assist operators in complying with 14 CFR Part 43, the following table shows the relationship between the TSO-C112e marking scheme and the Part 43 Appendix F requirement. Equipment approved under TSO versions previous to TSO-C112c are not affected, and may continue to use the marking from the equipment directly. Manufacturers of TSO-C112e equipment are encouraged to include this cross-reference information in their operating guide and maintenance instructions until such time that 14 CFR Part 43 Appendix F is revised. In addition, the relevant portions of DO-181E regarding labeling scheme (Sections 1.4.3 through 1.4.6) is repeated below in **Table 2** as a courtesy to operators and repair stations.

Table 1 –TSO-C112e marking and Part 43 Appendix F class:

ATC Mode S Transponder Equipment Part 43 Appendix F Class Reference	
TSO-C112e Transponder[1] marking:	14 CFR Part 43[2] Appendix F class:
Level 1, Class 1	Class 1A
Level 1, Class 2	Class 1B, with optional 1090 ± 1 MHz reply frequency
Level 2, Class 1	Class 2A
Level 2, Class 2	Class 2B, with optional 1090 ± 1 MHz reply frequency
Level 3, Class 1	Class 3A
Level 3, Class 2	Class 3B, with optional 1090 ± 1 MHz reply frequency
Level 4, Class 1	Class 4
Level 4, Class 2	Class 4, except for RF peak output power and suppression which should apply Class 3B
Level 5, Class 1	Class 4
Level 5, Class 2	Class 4, except for RF peak output power and suppression which should apply Class 3B
[1] Per RTCA Document DO-181E, Section 1.4.6 – with options noted in Section 1.4.4 [2] The Part 43 marking shown here originated in the original version of TSO-C112	

Table 2 – Excerpt from RTCA Document DO-181E
(Reprinted with the permission of RTCA, Inc.)

1.4.3 Mode S Transponder Levels

Mode S transponders provide for both ground-to-air and air-to-air surveillance.

The data link function of Mode S transponders provides for information transfer in both directions between ground and air and between airborne units. Data link implementation varies and depends on the amount of information to be exchanged.

Possible implementation configurations and additional transponder features are summarized in the following paragraphs.

1.4.3.1 Level 1 Transponders

The Level 1 Transponder supports the surveillance functions of both ATCRBS and Mode S ground sensors and the surveillance functions of airborne interrogators. This transponder can also reply to an airborne interrogator thereby making its presence

known; to do this, it need only handle short interrogations and replies.

Level 1 Transponders **shall** have the capabilities prescribed for:

a. Mode A identity and Mode C pressure-altitude reporting,

b. ATCRBS/Mode-S all-call and Mode S-only all-call transactions,

c. Addressed surveillance altitude and identity transaction,

d. Lockout protocols,

e. Basic data protocols except data link capability reporting, and

f. Air-to-air service and squitter transactions.

Note: *Level 1 permits SSR surveillance based on pressure-altitude reporting and the Mode A identity code. In an SSR Mode S environment, technical performance relative to a Mode A/C transponder is improved because of Mode S selective aircraft interrogation.*

1.4.3.2 Level 2 Transponders

Level 2 Transponders **shall** have the capabilities of §1.4.3.1 and additionally support the receipt of long interrogations and the generation of long replies. The Level 2 Transponder supports all of the surveillance functions and also supports:

a. Bi-directional air-to-air information exchange

b. Ground-to-air data uplink, Comm-A

c. Air-to-ground data downlink, Comm-B

d. Multisite message protocol

e. Data link capability reporting

f. Aircraft identification reporting

g. TCAS/ACAS crosslink capability

h. Overlay Command Capability (see §2.2.19.1.12.1, §2.2.19.1.12.2 & §2.2.19.1.12.6.2)

The ground-air-ground data link capability comprises a multitude of services and can be implemented according to the number and kind of services available, depending on the mission requirements of the aircraft. Protocols provide a means of reporting to the ground the specifics of each individual installation.

Specific capabilities of a Level 2 or higher transponder have been defined for operation in European airspace. Requirements for Elementary Surveillance (ELS) and Enhanced Surveillance (EHS) compliant transponders are included in this document (§2.2.24 and §2.2.25). Specific data registers and content appropriate for these capabilities are provided.

1.4.3.3 Level 3 Transponders (Uplink ELM Capability)

In addition to the capabilities of the Level 1 and Level 2 Transponders, the Level 3 transponder is able to receive ELMs from the ground. ELMs are received in the Comm-C format and consist of a burst of uplink transmissions that need not be replied to individually but are acknowledged in a reply containing a summary of the received interrogations.

Level 3 Transponders **shall** have the capabilities of §1.4.3.2 and also those prescribed for ground-to-air Extended Length Message (ELM) communications.

Note: *Level 3 permits extended length data link communications from ground-to-air and thus may provide retrieval from ground-based data banks and receipt of other air traffic services which are not available with Level 2 transponders.*

1.4.3.4 Level 4 Transponders (Full ELM Capability)

In addition to all the capabilities of a Level 3 Transponder, the Level 4 Transponder can generate ELMs for transmittal to the ground by using the Comm-D format.

Level 4 transponders **shall** have the capabilities of §1.4.3.3 and also those prescribed for air-to-ground extended length message (ELM) communications.

Note: *Level 4 permits extended length data link communications from air to ground and thus may provide access from the ground to airborne data sources and the transmission of other data required by air traffic services which are not available with Level 2 transponders.*

1.4.3.5 Level 5 Transponders (Enhanced Data Link Protocol Capability)

In addition to the full ELM capability, the Level 5 Transponder can support the enhanced data link protocols. The protocols provide for increased data link capacity by permitting data link transactions with more than one Mode S interrogator at a time without the need for multisite coordination. These protocols are fully conformant to the data link transponder protocols description of §2.2.19.1 to §2.2.20.2.1 (the standard protocols) and are therefore compatible with interrogators that are not equipped for the enhanced protocol.

Level 5 transponders **shall** have the capabilities of §1.4.3.4 and also those prescribed for enhanced Comm-B and extended length message (ELM) communications.

Note: *Level 5 permits Comm-B and extended length data link communications with*

multiple interrogators without requiring the use of multisite reservations. The Level 5 Transponder has a higher minimum data link capacity than the other transponder levels.

1.4.4 Optional Additional Features

Some transponder installations may support additional features:

- **TCAS Compatibility** – TCAS compatible transponders will have the capabilities described in §1.4.3.2, §1.4.3.3, §1.4.3.4 or §1.4.3.5, (see §2.2.22).

- **Antenna Diversity** – in aircraft with gross mass in excess of 5700 kg or a maximum cruising true airspeed capability in excess of 324 km/h (175 kt), or co-installation with airborne collision avoidance systems may require the transponder to operate in the diversity mode, i.e., the use of two antennas, receivers and transmitting channels.

- **Extended Squitter** – Extended squitter transponders will have the capabilities of §1.4.3.2, §1.4.3.3, §1.4.3.4 or §1.4.3.5 also in addition to those prescribed for extended squitter operation (see §2.2.23). The requirements for Extended Squitter message formats and information content are contained in the Minimum Operational Performance Standards for 1090 MHz Extended Squitter Automatic Dependent Surveillance Broadcast (ADS-B) and Traffic Information Services Broadcast (TIS-B) (RTCA DO-260B / EUROCAE ED-102A or latest version).

- **Dataflash Application** – transponders implementing Dataflash mode will adhere to the requirements contained in Appendix C.

- **Hijack Mode Capability** – Transponders implementing the Hijack mode will adhere to the requirements contained in Appendix D.

- **Elementary Surveillance** – elementary surveillance transponders will have the capabilities of §1.4.3.2, §1.4.3.3, §1.4.3.4 or §1.4.3.5 in addition to those requirements prescribed for elementary surveillance operation (see §2.2.24).

- **Enhanced Surveillance** – enhanced surveillance transponders will have the capabilities of §1.4.3.2, §1.4.3.3, §1.4.3.4 or §1.4.3.5 in addition to those requirements prescribed for enhanced surveillance operation (see §2.2.25).

- **Surveillance Identifier Code (SI)** – transponders with the ability to process SI codes have the capabilities of §1.4.3.1, §1.4.3.2, §1.4.3.3, §1.4.3.4 or §1.4.3.5 (see §2.2.14.4.37).

These additional features and corresponding identification codes are summarized in Table 1-1.

Table 1-1: Transponder Optional Additional Features

Additional Features	ID Code
TCAS Compatibility	a
Antenna Diversity	d
Extended Squitter	e
Dataflash	f
Hijack Mode Capability	h
Elementary Surveillance (only)	l
Enhanced Surveillance (including Elementary Surveillance)	n
Surveillance Identifier Code (SI)	s

Note: *SI capability is included by meeting the requirements in these MOPS.*

1.4.5 Minimum Output Power Level Designation

Two minimum peak output power levels are supported by this version of these MOPS, 125 watts (21.0 dBW), which is designated as Class 1 equipment, and 70 watts (18.5 dBW), which is designated as Class 2 equipment. For more information on output power levels, see §2.2.3.2.

Class 1 equipment is intended for use in aircraft that operate at altitudes above 15000 ft, or have a maximum cruising true airspeed in excess of 175 kt (324 km/h).

Class 2 equipment may be used in aircraft that operate at altitudes not exceeding 15000 ft, and have a maximum cruising true airspeed not exceeding 175 kt (324 km/h).

Note: *Level 4 or 5 transponders are not expected to be developed using Class 2 power.*

1.4.6 Transponder Labeling

Each transponder **shall** be clearly labeled with its actual functional level, minimum peak output power, and its optional additional features. The label **shall** contain the word "Level" followed by one digit between 1 and 5. (see §1.4.3.1 through § 1.4.3.5), followed by the ID Codes for the incorporated optional additional features as shown in Table 1-1, followed by the transponders' minimum peak output power designation as "Class 1" or Class 2" (see §1.4.5).

Example 1 – For a Level 2 transponder that incorporates Extended Squitter, Elementary Surveillance and SI capabilities with a minimum peak output power of 70 watts (18.5 dBW): the transponder would be labeled "Level 2els, Class 2."

Example 2 – For a Level 4 transponder that incorporates TCAS compatibility, antenna diversity, Extended Squitter, Enhanced Surveillance and SI capabilities, with a

minimum peak output power of 125 watts (21.0 dBW), the transponder would be labeled "Level 4adens, Class 1."

The label should be clearly visible when the transponder is mounted on the aircraft. In the case of a change of transponder level or capability, the label must be changed appropriately.

Note: *For transponders where "Level" or "additional features" might be changed through an approved software update, a means to display the labeling electronically would meet the above intent.*

Appendix 2. Modifications of the Requirements in RTCA DO-181E

1. Purpose. This appendix amends RTCA DO-181E, "*Minimum Operational Performance Standards for Air Traffic Control Radar Beacon System/Mode Select (ATCRBS/Mode S) Airborne Equipment*", dated 17 March, 2011. RTCA DO-181E as amended by this appendix defines the performance standard for Mode S transponders. Text from RTCA DO-181E is provided here as needed to provide context.

1.1. Text added to modify RTCA DO-181E is underlined. Text to be removed is lined through.

2. Replies to Multiple Comm-B Messages

2.1. RTCA DO-181E, page 87, section 2.2.19.1.12.5 is modified here to ensure multiple Comm-B message changes are processed properly.

2.2.19.1.12.5 **Comm-B Broadcast**

Notes

1 A Comm-B broadcast is a message directed to all active interrogators in view. Messages are alternately numbered 1, 2 and are available for 18 seconds unless a waiting air-initiated Comm-B interrupts the cycle. Interrogators have no means to cancel the Comm-B broadcast.

2 If there is more than one Comm-B message waiting for transmission, the timer is only started once the message becomes the current Comm-B broadcast.

A Comm-B broadcast starts, when no air-initiated Comm-B transaction is in effect, with the loading of the broadcast message into the Comm-B buffer, insertion of DR codes 4, 5, 6 or 7 into downlink transmissions of DFs 4, 5, 20, 21 and with the starting of the B-timer for the current Comm-B message. On receipt of the above DR codes, interrogators may extract the broadcast message by transmitting RR=16 with DI≠3 or 7, or with DI=3 or 7 and RRS=0 in subsequent interrogations. The change of the DR value is used by the interrogator to detect that a new Comm-B broadcast is announced and to extract the new Comm-B message. A new Comm-B broadcast shall not interrupt a current Comm-B broadcast. When the B-timer runs out after 18 ±1 seconds, the transponder will reset the DR codes as required, will discard the previous broadcast message and change from 1 to 2 (or vice versa) the broadcast message number.

If an air-initiated Comm-B transaction is initiated during the broadcasting interval (i.e., while the B timer is running), the B timer is stopped and reset, the appropriate code is inserted into the DR field and the Comm-B transaction proceeds per Figure 2-20. The previous Comm-B broadcast message remains ready to be reactivated for 18 ±1 seconds after conclusion of the air-initiated Comm-B transaction.

Waiting Comm-B broadcasts shall be retained for transmission once the current Comm-B broadcast is finished. If the contents of a waiting Comm-B broadcast changes, only the most recent value shall be broadcast. This prevents multiple changes from generating a sequence of broadcasts. Currently only BDS registers 1,0, Downlink Capability Report and, 2,0, Flight ID, make use of the Comm-B Broadcast protocol.

2.2. A test procedure is added here to ensure the modified requirements in section 3.1 of this appendix are met. This test is intended to follow RTCA DO-181E, section 2.5.4.21A, on page 284.

2.5.4.21B Procedure #21B Processing of multiple Comm-B messages

Test Procedure (§2.2.19.1.12.5 protocol)

Notes:

1. *The command to the transponder that a Comm-B broadcast message shall be sent originates in a peripheral device or in the device that holds the extended capability report.*
2. *The Comm-B broadcast does not affect the existing Comm-B protocol, air or ground initiated. The existing test procedures remain unchanged.*
3. *Verification of interface patterns is already part of the Comm-B test procedures and need not be repeated for the Comm-B Broadcast.*

This test procedure verifies that multiple Comm-B broadcast messages are queued and processed correctly.

Generate 1 flight identification change followed by a data link capability report change and 2 more flight identification changes in less than 18 seconds.

Verify that:

1 The first Flight ID change is available as a Comm-B Broadcast.

2 The data link capability report change is made available as a Comm-B broadcast after the Flight ID Broadcast times out.

3 The last flight ID change is made available as a Comm-B Broadcast after the Data Link Capability Broadcast times out.

4 All three Comm-B Broadcasts are available for 18 +/- 1 seconds each.

* * * * *